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The High Cost of Protecting Uruguay's Automotive Industry

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Uruguay loses between $17 million and $35 million a year by protecting its automobile industry. Uruguayan consumers lose between $70 billion and $80 billion a year on automobiles, transferring $36 million to $44 million to domestic assembly operations and components manufacturers.

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This paper — a product of the Trade Policy Division, Country Economics Department — was prepared as background material for the joint UNDP/World Bank Trade Expansion Program, which provides technical and policy advice to countries that want to reform their trade regimes. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Dawn Ballantyne, room N10-023, extension 37947 (26 pages).

Domestic content requirements are regulations that mandate minimum percentages of domestic value-added, or domestic components for products sold within the country, or provide strong incentives to substitute domestic for imported inputs.

Australia, Canada, and many Latin American countries have used regulations of this type to foster a domestic motor vehicle industry. The result is often domestic assembly operations that import "kits" or sets of components from abroad and combine them with domestically produced components to produce a finished vehicle. Some countries superimposed export promotion policies on these domestic content requirements.

Takacs developed a model to investigate the distortions, costs, and transfers among groups caused by the combination of domestic content and compensatory export requirements. She applied that model to the protection scheme for Uruguay's automobile industry.

She found that the protective regime keeps vehicle prices and domestic production costs high and transfers large sums to special interest groups.

Higher finished vehicle prices encourage more output from domestic assembly operations, but domestic content and compensatory export requirements discourage domestic assembly. The net effect could either encourage or discourage domestic assembly operations, depending on the net impact of the regulations. In Uruguay, the effect is to encourage domestic assembly.

Part of the consumer loss from higher prices represents a transfer to the assembly industry; part a transfer to the domestic components manufacturers; and part is an efficiency loss because domestic production and assembly is costlier than domestic production and assembly on the world market.

Trade in this industry should be liberalized. It would be possible to do so gradually within the framework of the current protective regime. Care should be taken not to inadvertently increase effective protection of the assembly industry by, for example, phasing out domestic content and compensatory export requirements on kits faster than those on finished autos — thus temporarily encouraging domestic assembly.

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I. INTRODUCTION

Domestic content requirements are regulations that mandate minimum percentages of domestic value-added, or domestic components for products sold within the country, or provide strong incentives to substitute domestic for imported inputs. Many Latin American countries, Canada, and Australia[1] have used regulations of this type as part of import-substitution industrialization strategies to foster a domestic motor vehicle industry. These protective regimes often resulted in domestic assembly operations that import "kits", or sets of components from abroad, and combine them with domestically produced components to put together a finished vehicle.

As the limits of import substitution industrialization were reached, and interest shifted toward export promotion, many countries superimposed export promotion policies on the underlying domestic content requirements. Brazil (and for a time Argentina) offered tax exemptions and waiver of import deposit requirements if certain amounts of output were exported.[2] For a period of time Argentina linked approval for expansion of domestic output to fulfillment of quantitative export targets.[3] In other countries, such as Mexico[4] and Uruguay[5] export promotion took the form of more explicit "compensatory export requirements" which are required exports of automobile industry products equal to specified percentages of the value of imported kits or finished vehicles.

The purpose of this paper is to develop a model to investigate the distortions, costs, and transfers among groups caused by the combination of domestic content and this last form of export promotion, compensatory export requirements. The model is then applied to make some rough estimates of the

order of magnitude of the costs and transfers arising from the Uruguayan automobile industry protection scheme.

II. A MODEL OF DOMESTIC CONTENT AND COMPENSATORY EXPORT REQUIREMENTS

This section develops a model to assess the major impacts of the domestic content and compensatory export requirements and the interaction between them. The model simplifies by ignoring differentiation among types of components, the trade-off between domestic content and compensatory exports, regulations on minimum disassembly of components in kits, and prohibitions against importing certain components. The model also assumes a small importing country with competitive components and assembly industries, and assumes that the domestic content requirements and all compensatory export requirements are binding (that is, less domestic content would be used by assembly firms if there were no domestic content requirements, and exports of components would be less than the observed values in the absence of compensatory export requirements).[6]

Suppose that the country imposing the domestic content and compensatory export requirements is small, so that the world price, or import price, of assembled autos (P_A^*) and of auto components (P_C^*) are both given. Assume that there is only one type of finished or assembled automobile, made through a process of assembling a given number, "α" of components.[7] For the moment, ignore differences among components. A perfectly competitive domestic components industry manufactures components and a perfectly competitive domestic industry assembles autos from imported and domestically produced components. Finished autos can be imported, subject to compensatory export

requirements. The domestic assembly industry is subject to domest ' content requirements and compensatory export requirements for a package of imported components, called a "kit". Equilibrium prices and quantities in the market for assembled autos and in the market for components will be determined jointly because they are tied together not only by the normal input-output relationships, but also by the domestic content and compensatory export requirements.

The Domestic Market for Assembled Autos

Importation of assembled autos requires compensatory exports of x_A of the value of the imported auto. (If compensatory exports equal to 50% of the value of the imported auto are required, then x_A=0.5.) The value of compensatory exports required per auto would be $x_A P_A^* = P_C q_C$ where q_C is the quantity of components that must be exported per imported finished auto. If these components sell in the world market at P_C^*, the cost to the firm of the required compensatory exports would be $(P_C - P_C^*)q_C = ((P_C - P_C^*)/P_C)x_A P_A^*$. An <u>ad valorem</u> tariff rate of t_A on autos in addition to the compensatory export requirements, will increase the cost of the imported vehicle by the amount of the duty. Thus the cost of an imported auto will be $P_A^*(1+t_A) + x_A((P_C - P_C^*)/P_C)P_A^*$.

Given that in the long run a perfectly competitive industry would be expected to make zero economic profits, in the long run the total cost of the imported assembled vehicle equals price, so:

$$P_A^*(1+t_A+x_A(P_C-P_C^*)/P_C)) = P_A \qquad (1)$$

where P_A and P_C are the domestic prices of assembled vehicles and components, respectively. The last equality results from the long-run zero profit

condition for a perfectly competitive industry. Given the world prices of assembled autos and components and the price of domestic components, (1) determines the domestic market price of assembled autos. Given that price, the quantity of assembled autos sold (domestically assembled from kits and domestic components plus imported already assembled) will be determined by the domestic demand for finished autos:

$$D(P_A) = M_A + Q_A \qquad (2)$$

Suppose that there is an upward sloping supply function of value-added in domestic assembly operations, in which the quantity of autos firms are willing to assemble increases as the value-added per unit (VA) increases, as in (3):

$$VA = V(Q_A) \qquad V' \text{ positive} \qquad (3)$$

where Q_A is the quantity of finished autos produced. Suppose that the assembly technology requires a certain number of components, "α" per auto. Let "δ" be the proportion of total components that must be of domestic origin.[8] If 20 percent domestic content is required, then δ=0.2. Let x_k be the compensatory export requirement for <u>kits</u>, that is, the proportion of the value of the imported kit that must be compensated by exports of auto industry products. Then $\alpha(1-\delta)P_c^*$ is the value of a kit at world market prices. Given the compensatory export requirements, the value of compensatory exports required to import the kit would be $x_k\alpha(1-\delta)P_c^* = P_c q_c$, where q_c is the quantity of compensatory exports required to import one kit. The tariff on kits would increase the cost of kits to the domestic assembly industry by the tariff revenue that would have to be paid per kit, or $\alpha(1-\delta)P_c^* t_k$. The cost of domestic components would equal $\alpha\delta P_c$. The assumption of a perfectly

competitive assembly industry implies that in the long-run unit cost equals price, so:

$$P_A = \alpha(1-\delta)P_C^*(1+t_K+x_A(P_C-P_C^*)/P_C) + \alpha\delta P_C + V(Q_A) \qquad (4)$$

Equation (4) can be thought of as the long-run assembly industry inverse supply curve. It is constructed by adding vertically the domestic value-added that would be required for firms to be willing to assemble various quantities of vehicles, the cost per vehicle of domestic components used as intermediate inputs ($\alpha\delta P_C$) and the effective cost of the imported kit which would equal $\alpha(1-\delta)P_C^*(1+t_A+x_K(P_C-P_C^*)/P_C)$. Equations (1)-(4) determine P_A, M_A, Q_A, and D_A, given P_C, P_A^*, P_C^*, t_A, t_K, x_A, x_K, α and δ. The market for assembled autos is depicted graphically in the upper quadrant of Figure 1.

The price of autos to consumers would be P_A. This lies above the world price of P_A^* by an amount equal to the extra costs imposed by the tariff ($t_AP_A^*$) and compensatory export requirements on assembled autos ($x_A((P_C-P_C^*)/P_C)P_A^*$). At this price, consumers would demand D_A vehicles.

The supply curve of the domestic assembly operations is shown in Figure 1 by S_A. As explained in more detail in the section on the costs of protection below, S_A is the vertical sum of the supply curve under free trade (S_A^*), the increase in assembly industry costs per vehicle due to the tariff ($\alpha(1-\delta)P_C^*t_K$), and the increase in costs attributable to the domestic content and compensatory export requirements ($\alpha\delta(P_C-P_C^*)+\alpha(1-\delta)x_K(P_C-P_C^*)P_C^*/P_C$). At a price of P_A, the domestic industry would produce Q_A. The difference between the quantity demanded and supplied would be the quantity imported, M_A.

The various elements of the protective regime influence the market for assembled vehicles in potentially contradictory ways. The compensatory export

requirements for the importation of assembled vehicles and the tariff on assembled vehicles drive up importer costs, and thus increase the price of the finished vehicle to the consumer. Higher finished vehicle prices encourage greater output from domestic assembly operations, but on the other hand the domestic content and compensatory export requirements for kits and the tariff on kits discourage domestic assembly operations by increasing input costs. This shows up as an upward shift in the supply curve for vehicles assembled within the country.

The Domestic Market for Components

Assume that the perfectly competitive domestic components industry has a supply curve for components, given in inverse form by:

$$P_C = S(Q_C) \qquad S' \text{ positive} \qquad (5)$$

where Q_C is the quantity of components supplied by the domestic industry. The demand for domestic components arises from three sources: 1) the demand for components to be combined with imported kits for domestic assembly ($\alpha\delta Q_A$); 2) exports of components as compensatory exports for the importation of kits (X^K); and 3) exports of components as compensatory exports for the importation of assembled vehicles (X^A). Thus:

$$Q_C = X^A + X^K + \alpha\delta Q_A \qquad (6)$$

Given the compensatory export requirements, $P_C X^A = x_A P_A^* M_A$ and $P_C X^K = x_K \alpha(1-\delta) P_C^* Q_A$, so (6) can also be expressed as:

$$Q_C = x_A M_A (P_A^*/P_C) + x_K \alpha(1-\delta) Q_A (P_C^*/P_C) + \alpha\delta Q_A \qquad (7)$$

Equation (7) can be thought of as the demand curve for domestic components. Equations (5) and (7) determine P_C and Q_C, given Q_A, P_A^*, P_C^*, x_A, x_K, α, and δ.

The equilibrium in the market for components is depicted graphically in the lower quadrant of Figure 1.

The supply curve of the domestic components industry is shown by S_C. The demand curve for components, D_C, is the horizontal sum of the demand for components by domestic assemblers $(D_{da})^9$, the demand for components for export to satisfy compensatory export requirements for imported kits (D_{xk}), and the demand for components to satisfy compensatory export requirements to import assembled vehicles (D_{xa}).

Equilibrium in the components market would occur at the price/quantity combination P_C and Q_C. Under free trade, domestic producers would be forced to match the world market price of components P_C^*, at which price components production would be Q_C^*. The domestic content and compensatory export requirements all act to increase the demand for components produced within the country, driving up price and production.

Given the linkages between the markets for domestic components and assembled vehicles, equations (1)-(5) and (7) jointly determine the endogenous variables P_A, P_C, D_A, M_A, Q_A, and Q_C given the world market prices P_A^* and P_C^* and the policy parameters t_A, t_K, x_A, x_K, α, and δ. The equilibrium prices and quantities in both markets would be determined simultaneously.

III. TRANSFERS AMONG GROUPS AND NET COST OF THE PROTECTIVE REGIME

If there were no protective regime, and abstracting from transportation costs, the world market prices of both assembled autos and components would prevail within the respective domestic markets. In the components market, a quantity Q_C^* would be produced at the price P_C^*. The domestic assembly

operations would have access to components at this price, so their supply curve would be the vertical sum of the value-added per unit required for each output level and the cost of component inputs, αP_C^*. This supply curve is shown by S_A^* in the top quadrant of Figure 1. At the free-trade price P_t^*, the domestic industry would assemble Q_A^* units, consumers would purchase D_A^* units, so M_A^* assembled vehicles would be imported.

The costs of the entire protective regime can b assessed using the free-trade equilibrium as a benchmark for comparison. The domestic content requirements and compensatory export requirements for the importation of kits increase input costs to assemblers, and th.s shift their supply curve upward to S_A'. The size of the upward shift is $\alpha\delta(P_C-P_C^*)+\alpha(1-\delta)x_t(P_C-P_C^*)P_C^*/P_C$, equal to the distance yl in Figure 1. The tariff on kits shifts the supply curve upward by an amount equal to $\alpha(1-\delta)P_C^*t_k$, which is represented in Figure 1 by the distance by. The domestic content requirements, compensatory export requirements, and tariff taken together shift the assembler's supply curve from S_A^* to S_A.

The welfare costs can be measured as the effects of distortions in the markets for assembled vehicles and components. The cost to consumers of the restrictions is area adek, the reduction in consumer surplus as compared to free trade. Of this, area def is the traditional deadweight loss in consumption due to higher assembled auto prices.

Area bdfh resembles tariff-equivalent revenue, in that the height of the rectangle is the difference between domestic and import price and the width is the number of vehicles imported fully assembled. Of this, however, only area bdwx represents tariff revenue collected on imported vehicles. The distance

wf can be thought of as the implicit tariff on assembled autos imposed by the compensatory export requirements. Area xwfh represents the "tariff equivalent revenue" associated with the increase in importers' costs because of the compensatory export requirements. This area is part transfer to domestic components manufacturers and part deadweight loss due to increased relatively high cost production in the domestic components industry. The nature of the transfer and loss can be seen by noting that area xwfh equals area pqrs in the lower quadrant of Figure 1[10], which is composed of the extra cost of producing pq units of components within the country rather than importing them (the area under the components supply curve above the world market price P_C*), and area pqv, which is a transfer in the form of higher short-run profits to components manufacturers for the extra output pq ($=\alpha x_K M_A$). Area pqrs also can be thought of as the value of the subsidy to components exports generated by the compensatory export requirements on finished autos. It represents the difference between domestic and world market components prices (qr) times the quantity of compensatory exports needed to allow vehicle imports (pq). This export subsidy is a transfer from domestic consumers to components exporters, using vehicle importers as intermediaries.

The compensatory export requirements for kits and the domestic content requirements shift up the assembler's supply curve from S_A to S_A' (=yl), so, at the resulting domestic level of assembly operations Q_A, area zyln represents the extra cost of components to assemblers because of the existence of these restrictions. The increased cost to domestic assemblers of area zyln is in part a transfer to domestic manufacturers of components and in part a deadweight efficiency loss. To see how the area is divided, note that area

zyln in the upper quadrant of Figure 1 equals area opsu in the lower quadrant of the same diagram.[11] Area opvtu represents a transfer to the domestic components manufacturers in the form of higher profits, and area vst represents a deadweight loss due to the excess of production costs domestically over the price at which the components could have been purchased in the world market, for the extra output op produced because of the domestic content requirements and the compensatory export requirements for kits. Area cpsg can be thought of as the value of the subsidy to components exports due to the compensatory export requirements for kit imports. It is in essence a transfer from domestic consumers to components exporters, using assemblers as intermediaries.[12]

Area nlik represents an increase in profits to domestic assembly operations due to the net effect of the entire protective regime. Area lhi represents a production deadweight loss, the extra cost of assembling Q_A-Q_A* vehicles within the country rather than buying them in the world market at P_A*.

To summarize the net welfare effect of all of the restrictive measures taken together, the regime imposes losses on consumers equal to area adek, of which nlik represents a transfer to domestic assemblers of autos, abyz a transfer to the government in the form of tariff revenue on kits, zyln represents a transfer to domestic components manufacturers (equal to area opvtu) plus deadweight production loss (equal to area vst), def is a deadweight loss due to the consumption distortion in the market for assembled autos, lhi is a deadweight production loss due to high-cost assembly of autos domestically, bdwx is tariff revenue on autos, and xwfh represents a loss to consumers that is in part transfered to components manufacturers (area pqv)

and in part deadweight loss (area qrsv). The net effect, ignoring transfers, is a consumption loss of def, and production deadweight losses of lhi and qrt in the assembly and components industries, respectively.

The transfers from consumers to both the domestic assembly and the domestic components industry show that both assemblers and manufacturers of components can gain from the protective regime, but in some respects their interests are contradictory. From the point of view of the manufacturers of domestic components, the more restrictive the domestic content requirements and both compensatory export requirements, the greater their gains. From the point of view of the domestic assembly industry, the more demanding the compensatory export requirements for assembled autos (the higher x_A, holding δ and x_K constant), the greater their gains. However, holding constant the compensatory export requirement for assembled autos (x_A), the more restrictive the domestic content requirement (the higher δ) and the more severe the compensatory export requirements for kits (the higher x_K), the smaller will be the gains to domestic assembly operations. Note that the assemblers need not necessarily gain on balance from the regime. Sufficiently high δ and x_K relative to x_A could leave the domestic assemblers with a net loss and, on balance, discourage rather than encourage domestic assembly of automobiles. In light of this analysis it is not surprising that the domestic assemblers are arguing that the compensatory export requirements for assembled vehicles are low relative to those for kits.[13]

IV. CALCULATION OF TRANSFERS AND COSTS IN URUGUAY

The protective regime for the Uruguayan motor vehicle sector is made up of a combination of tariffs on imported vehicles and parts, domestic content

requirements for domestic assembly operations, and compensatory export requirements for both imported vehicles and components for domestic assembly. To import fully assembled vehicles firms pay a tariff of 40 per cent, and must export automobile industry products with a value added in Uruguay equal to 70 percent of the FOB value of the imported vehicle. In general, the exports must take place before the new vehicle can be imported.

To import kits firms must pay a tariff of 10 percent and comply with both domestic content requirements and compensatory exports provisions. The domestic content requirements for assembly of passenger vehicles from kits mandate that a minimum of 20% of the value of the product must be of national origin. With the minimum 20% domestic content, compensatory exports of 60% of the FOB value of the kit are required. A tradeoff of domestic content for compensatory exports is allowed at a ratio of 1 to 2, that is, for each percentage point of domestic content added, the compensatory exports required fall by 2 percentage points. For example, compensatory exports can decrease to 50% if domestic content is increased to 25%.[14]

Observers of the automobile industry in Uruguay and the compensatory export system report that a "market" has developed in the credits for compensatory exports. Firms assembling vehicles domestically that must have compensatory exports to import kits pay exporters of parts to credit the exports to their names. Different observers report that the premium paid by firms to have exports credited to them normally varies from 5 to 15 percent of the value of the invoices, with a average of about 8 percent, but has reached as high as 30 percent in times of very high domestic demand.

The magnitude of the areas in Figure 1 identified above as net welfare losses and transfers can be calculated based on the actual values of the

policy parameters t_A, t_C, and x_A, the average values of x_K and δ chosen by assembly operations, given the available trade-off, and observed values of prices, quantities, and premia paid for export invoices for compensatory exports.

The consumer loss is area adek in Figure 1. Let $\pi=(P_C-P_C^*)/P_C$ be the premium paid for invoices to be credited as compensatory exports, and η_{DA} be the elasticity of demand for assembled vehicles. Then, given that $(P_A-P_A^*) = P_A^*(t_A+x_A\pi)$ and $(D_A^*-D_A) = \eta_{DA}(D_A/P_A)P_A^*(t_A+x_A\pi)$,

$$\begin{aligned}\text{Area adek} &= (P_A-P_A^*)D_A + 1/2(P_A-P_A^*)(D_A^*-D_A)\\ &= P_A^*(t_A+x_A\pi)(D_A+1/2(D_A^*-D_A))\\ &= P_A^*D_A(t_A+x_A\pi)(1+1/2\,\eta_{DA}(t_A+x_A\pi)).\end{aligned} \tag{8}$$

The deadweight loss in consumption, area def, would be:

$$\begin{aligned}\text{Area def} &= 1/2(P_A^*(t_A+x_A\pi))(D_A^*-D_A)\\ &= 1/2(P_A^*(t_A+x_A\pi)^2\eta_{DA}D_A/P_A\\ &= 1/2P_A^*D_A(t_A+x_A\pi)^2\eta_{DA}\end{aligned} \tag{9}$$

The gain to the assembly industry (area nlik) and the deadweight loss to the economy from excess assembly operations (area lhi) can be calculated by first noting that the height of each of these areas equals the net impact of the restrictive regime, that is, the amount, net of cost increases, by which revenue per unit exceeds free-trade revenue. Let this distance (nk=lh) be designated N:

$$N = P_A^*t_A + x_A\pi P_A^* - \alpha(1-\delta)t_KP_C^* - \alpha\delta\pi P_C - \alpha(1-\delta)x_K\pi P_C^*$$

Let $\sigma = \alpha P_C^*/P_A^*$ be the share of components production in the final cost of a finished vehicle. Then:

$$N = P_A^*(t_A+x_A\pi-\sigma((1-\delta)(t_K+x_K\pi)+\delta\pi/(1-\pi))).$$

Let the elasticity of the supply of vehicle assembly with respect to value added be ϵ_{SA}, and note that $(Q_A-Q_A^*) = \epsilon_{SA}(Q_A/(P_{A^*+N}))N$. Then,

$$\text{Area lhi} = 1/2\ (P_A^*(t_A+x_A\pi)-P_C^*\alpha(1-\delta)(t_R+x_R\pi+\alpha\delta\pi))(Q_A-Q_A^*)$$

$$= 1/2\ N^2\epsilon_{SA}Q_A/(P_A^*+N). \qquad (10)$$

The gain to the assembly industry, area nlik, can be calculated as area nlhk less area lhi, or:

$$\text{Area nlik} = Q_A\ N - 1/2\ N^2\ \epsilon_{SA}\ Q_A/(P_A^*(1+x_A\pi) \qquad (11)$$

Let ϵ_{SC} be the elasticity of supply of components, and $V_C=P_CQ_C$ be the value of domestic components production. The deadweight loss from excess production in the components industry is shown in Figure 1 as area qrt.

$$\text{Area qrt} = 1/2(P_C-P_C^*)(Q_C-Q_C^*)$$

$$= 1/2\pi P_C\epsilon_{SC}(Q_C/P_C)\pi P_C$$

$$= 1/2\ V_C\epsilon_{SC}\ \pi^2 \qquad (12)$$

The transfer to the domestic components industry as a result of the protective regime is area oqtu, which equals area oqru less the deadweight loss:

$$\text{Area oqtu} = (P_C-P_C^*)Q_C - 1/2\ V_C\epsilon_{SC}\pi^2 = V_C\pi - 1/2\ V_C\epsilon_{SC}\pi^2. \qquad (13)$$

Application of the model to the Uruguayan protective regime requires data on quantities assembled, sales, import price of assembled vehicles, deviation of components prices from world prices, the ratio of components cost to the final price of a finished vehicle, and the value of components production. The data used for the variables that appear in the above equations are:

DATA USED IN CALCULATIONS OF IMPACT OF DOMESTIC CONTENT AND COMPENSATORY EXPORT REQUIREMENTS

Variable	Value	Measure and (Source)
π	0.08	Percentage of value of invoice paid to exporter of components for invoices to be credited for purposes of fulfilling compensatory export requirements (Verbal estimates of individuals interviewed)
t_A	0.561	Price increasing effect of the 40 percent tariff on assembled automobiles, taking into account that the tariff-inclusive price is the base for the internal tax (impuesto especifico interno) of 15 percent and the tax-inclusive price is the base for the 22 percent value-added tax: $t_A = .40(1.15)(1.22)$
t_K	0.165	Price-increasing effect of tariff of 10 percent on kits, which only applies to approximately 14 percent of imported kits (because imports from Brazil and Argentina are exempt from duty under bilateral trading arrangements), taking into account that kits are subject to an internal tax of 12 percent and a 22 percent value-added tax: $t_K = 0.14(.1)(1.12)(1.22)+12(1.22)^{15}$
x_A	0.70	Compensatory export requirement for assembled vehicles
x_K	0.53	Ratio of compensatory exports to kit imports chosen by firms (based on data from 2 firms representing 27% of the market)
δ	0.235	Average domestic content ratio chosen by domestic assembly firms (based on data from 2 firms representing 27% of the market)
P_A^*	US$8086	Unit Value of imported assembled vehicles (1989) Categories A, C, D, E, and H (Camara de Fabricantes de Automotores)
Q_A	11,690	Number of vehicles assembled in Uruguay (1989) Categories A, C, D, E, and H (Camara de Fabricantes de Automotores)
Q_D	12,237	Number of vehicles sold in Uruguay (1989) (Calculated as Q_A plus 529 assembled vehicles imported)
σ	0.621	Share of components cost in final cost of assembled vehicle (weighted average of data on costs of domestic

components and kits as a share of final sales prices for 4 Uruguayan assembly firms representing 70-80 percent of the industry, using 1989 units assembled as weights)

V_c Value of components production (Calculated within the program as: 0.53(value of kit imports) + 0.7(value of finished vehicle imports) + 0.235(value of assembled vehicles sales ($-Q_A P_A^*$)

Tentative estimates of the magnitude of the welfare effects of the protective regime were calculated using equations 9 through 13, the above data, and assumed combinations of elasticities of demand of -0.5 and -1.0 and elasticities of supply of 1.0 and 2.0.

Table 1 presents the estimates of the magnitude of the loss to buyers of vehicles, the transfers to the domestic assembly and components industries, and the efficiency losses, or net costs, of the protective regime. In the market for vehicles, the results indicate a loss to buyers of vehicles of 70 to 80 million US dollars per year, depending upon the assumed elasticities. The estimated transfer from buyers of vehicles to the domestic assembly industry ranges from 32 to 40 million US dollars, and the efficiency losses in the assembled vehicles market range from 17 to 35 million. In the components market, the estimated transfer to producers is between about 4.5 million US dollars, while the estimated efficiency loss varies between 0.2 and 0.4 million. These last estimates seem small, and are probably underestimated, for reasons explained below.

The estimates should be considered illustrative and tentative for a number of reasons:

1. They are based on a range of assumed elasticities of demand for automobiles in the Uruguayan market, and assumed elasticities of supply of components and assembled vehicles by Uruguayan producers.

While these elasticities are reasonably close to those estimated for other markets, and are similar to elasticities frequently assumed in the absence of actual estimates, they are not based on elasticities estimated on the basis of Uruguayan data.

2. The range of values for the percentage of the invoice value paid to domestic components manufacturers for invoices is based on verbal estimates of individuals familiar with the industry or involved with the administration of the system, rather than actual observed data.

3. The model assumes a homogeneous output ("assembled auto") and a homogeneous input ("components"). This is an obvious oversimplification, which biases the estimates of the protection and transfers to the assembled vehicle sector upward and those to the components industry downward. The overestimate of protection to assembled vehicles arises because the models that are imported fully assembled tend to be more luxurious and expensive than those assembled in Uruguay. The loss to consumers is based on percentage price increases using this average import price as the base. The underestimate of the degree of protection and transfers to the components industry arises because those components exported will tend to be those that are most competitive on the world market. The premium on export invoices is thus the premium necessary to allow exportation of the most competitive components. The deviation of domestic price from world market price for the least competitive components is undoubtedly much larger.

3. Distortions due to the preferential trading arrangements with Argentina and Brazil also bias downward the magnitude of the transfer to

th· domestic components industry and the efficiency losses caused by the domestic content requirements. The impact of the regime on the components industry is very sensitive to variation· in the size of the deviation of domestic components prices from world prices. This deviation is measured in this model by the percentage premium paid by importers of assembled vehicles and kits for export invoices to credit toward their compensatory export requirements. To the extent that compensatory exports are shipped to the protected markets of Brazil and Argentina under preferential trading arrangements rather than to the world market, the estimated average premium will be less than that which would be necessary to ship to the world market. This is not a problem with respect to measuring the cost imposed upon Uruguayan auto buyers by the compensatory export requirements. (It does, however, lead to the observation that in the absence of the preferential trading arrangements, the costs of the regime could be much higher, because compensatory exports would have to receive an implicit subsidy high enough to make them competitive in the world market[16].) The effect of the domestic content requirements will be underestimated, however, because the relevant price differential in that case is the difference between world market and domestic prices which is underestimated by the premium paid for export invoices. Given that the estimates of the transfers to the components industry and the efficiency losses from protected components production are very sensitive to this parameter, there is reason to believe that the method applied here yields estimates of the degree of protection to the components industry that are biased downward, perhaps significantly.

V. CONCLUSIONS

The automobile protective regime in Uruguay is made up of a complicated set of regulations. Imports of both vehicles and components are subject to tariffs. Firms are constrained with respect to the number of models produced, the number of vehicles per model, and the amounts of imported versus domestic components used and must export automobile industry products equal to given percentages of the value of kits and assembled vehicles imported.

The model developed to analyze the impact of the protective regime indicates that domestic content requirements, compensatory export requirements, and tariffs on finished vehicles and kits keep vehicle prices high, maintain high-cost domestic production of both vehicles and components, and transfer large sums to special interest groups.

Compensatory export requirements and tariffs drive up the price of finished vehicles to consumers. The consumer loss is in part a transfer to the domestic producers in both the assembly and components industries in the form of higher profits, and in part efficiency losses, or net losses, due to the distortion of consumer decisions and production levels.

The various elements of the protective regime affect domestic assembly operations in different, and potentially contradictory, ways. Higher finished vehicle prices encourage greater output from domestic assembly operations, but on the other hand the domestic content and compensatory export requirements for kits and the tariff on kits discourage domestic assembly activity by increasing input costs. On balance the net effect could either discourage or encourage domestic assembly operations, depending upon the net impact of the regulations. In the case of Uruguay, the protective regime appears to

encourage domestic assembly, so part of the consumer loss from higher prices represents a transfer to the assembly industry, and part represents an efficiency loss due to increased domestic assembly of vehicles at a higher cost than the price of assembled vehicles in the world market.

The domestic components producers are unambiguouly helped by all of the elements of the protective regime. The tariff on kits provides them with protection from imported components, the tariff on assembled vehicles helps maintain domestic assembly operations and the domestic demand for components, the domestic content requirements force domestic assembly operations to use domestically produced components, and the compensatory export requirements for the importation of both finished vehicles and kits increase the demand for domestically produced components for export. The compensatory export requirements in fact act like an export subsidy to the components industry. All the elements of the protective regime act to increase the demand for components produced within the country and drive up both price and output in the market for domestic components. Part of the consumer loss from higher finished vehicle prices thus takes the form of a transfer to domestic components manufacturers, and part represents an efficiency loss corresponding to the extra cost of producing components within the country that could be obtained at lower cost in the world market.

Preliminary estimates of the magnitude of these effects indicate that the protective regime imposes a loss on Uruguayan consumers of automobiles of from 70 to 80 million US dollars per year, while transferring from 36 to 44 million US dollars to domestic assembly operations and components manufacturers. The estimated net loss to the country ranges from about 17 to 35 US million dollars per year. These estimates must be considered tentative

because the model assumes a competitive industry, does not include some aspects of the protective regime, does not consider the differentiated nature of both autos and components, and are biased by trade distortions arising from the preferential bilateral arrangements with Brazil and Argentina.

Despite these caveats, the results indicate that the protective regime imposes substantial costs on consumers and encourages the allocation of resources in activities that are relatively high-cost. Given the costs and transfers involved, a reasonable course of action would be to eliminate the restrictions. Given that the industry has been protected for decades, eliminating the system overnight may lead to adjustment problems. Such a drastic step is not necessary, however, because the structure of the system lends itself to gradual liberalization. The major parameters of the system, specifically the percentage of domestic content required, the percentage of compensatory exports required for kits and finished vehicles, and the tariff rates for kits and finished vehicles could be lowered in stages according to a preannounced schedule to allow gradual adjustment.[17] During the process of liberalization care should be taken not to inadvertently increase the degree of effective protection to the assembly industry by, for example, phasing out domestic content and compensatory export requirements on kits faster than those on finished autos. Doing so could temporarily increase the costs of protection and provide false signals to domestic industry concerning the direction of adjustment by temporarily further encouraging domestic assembly operations.

ENDNOTES

1. See Lloyd (1973) and Munk (1969) for a description of the Australian and Latin American cases.

2. For a description of the Brazilian export promotion plan see Mericle (1984, pp. 29-32). Argentinean tax rebates are described in Jenkins (1985, p. 59).

3. See Jenkins (1985), p. 61.

4. See Bennett and Sharpe (1985) for a detailed description of the evolution of the Mexican motor vehicle industry protective regime.

5. For a detailed description of the Uruguayan protective regime and its administration, see Trade Policy Division, Country Economics Department, The World Bank (1990), Chapter 7.

6. The assumption of competition in the automobile industry is unrealistic for Uruguay, as it probably is for most developing countries. In 1989 there were about 10 motor vehicle assembly firms, two of which each accounted for about 1/3 of the domestic market. The model in this paper is intended to clarify the protective effects of and interactions between the domestic content and compensatory export requirements and provide rough estimates of the order of magnitude of the potential costs of the protective regime. Future work to take into account strategic interactions among firms could provide a richer analysis and possibly more accurate estimates of the true costs.

7. This approach is similar to Grossman (1981) in that it assumes that domestic and imported components are perfect substitutes. Mussa (1984) develops a model in which domestic and imported inputs are less than perfectly substitutable.

8. Grossman (1981) shows that the domestic content requirements will have different effects if defined in terms of physical quantities or value-added. The Uruguayan domestic content restriction is similar to a restriction in quantity terms because it uses set valuations, by weight, for the components. If P_C' is the set valuation, by weight, for the component of weight w_C, P_A' is the set valuation, by weight, for an assembled vehicle of weight w_A, and δ' the required ratio of the value of domestic components to the value of output, then the demand for components to be incorporated in domestically assembled vehicles (equivalent to $\alpha\delta Q_A$ in the text) would equal $(P_A'w_A/P_C'w_C)\delta'Q_A$.

9. Domestic content requirements are calculated using the weight of the components and officially determined prices, or "aforos" for the various types of components. This method implies that higher domestic component prices will not affect the quantity of domestic components demanded, so, given Q_A, the demand curve for components to be combined with kits will be vertical. The use of the system of aforos avoids the situation in which higher domestic component prices increases the value-added domestically and thus decreases the quantity of components necessary to fulfill the requirement.

10. area xwfh = $x_A((P_c-P_c^*)/P_c)P_A^*M_A^*$
$= D_{xs}(P_c-P_c^*)$ = area pqrs

11. area zyln = $(\alpha\delta(P_c-P_c^*) + \alpha(1-\delta)x_R(P_c-P_c^*)(P_c^*/P_c))Q_A$
$= (P_c-P_c^*)\ (\alpha\delta Q_A + \alpha(1-\delta)x_R Q_A(P_c^*/P_c))$
= ou(op)

12. It is interesting to note that the subsidy element to components exports was at times explicitly recognized by multinational firms. Bennett and Sharpe (1985, p. 186) report that Chrysler arranged for its Mexican assembly operations to transfer funds to its U.S. assembly operation to cover the extra cost of Mexican parts.

13. See Sevel Uruguay S. A., "La Industria Automotriz en Uruguay (September, 1989).

14. Data on the actual mix of compensatory export and domestic content requirements are available for two firms representing approximately 27 percent of the market in terms of the number of vehicles assembled in 1989. Compensatory exports averaged 53 percent of kit imports and dometic content averaged 23.5 percent.

15. The internal tax on kits is included in the calculation of the price-increasing effect of the tariff on kits because it directly effects assembly industry costs and thus supply. In this model the degree of protection to components manufacturers is measured by the premium on export invoices, which is assumed to measure the percentage difference between domestic and world market prices for components.

16. Another observation is that some of the costs of the Uruguayan automotive protective regime are being paid by users of components in Brazil and Argentina, who are paying higher prices for Uruguayan components than those components would cost at world market prices and by the Brazilian and Argentine governments in the form of foregone tariff revenue.

17. The more detailed provisions of the protective regime that specify that certain components must be imported as separate items could be eliminated immediately, or if this were considered too drastic, also phased out over time by eliminating components from the list item by item.

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TABLE 1

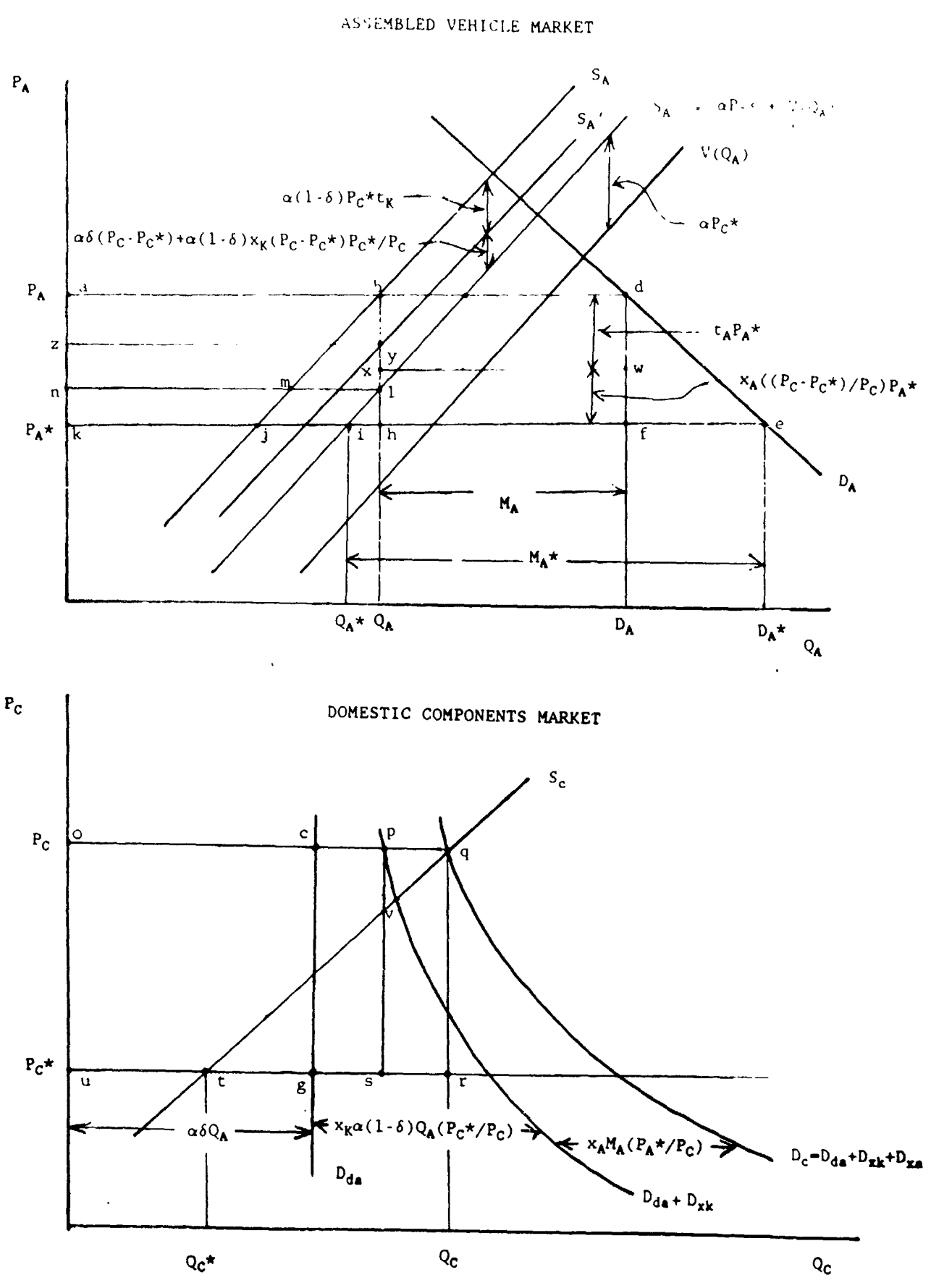
AUTOMOBILE INDUSTRY PROTECTION IN URUGUAY

Gains and Losses from Protective Regime (1989)

(Millions of US$)

	Assumed Parameters		
Premium on domestic Components (π)	π=0.08	π=0.08	π=0.08
Auto Demand Elasticity (η)	η_{DA}=1	η_{DA}=0.5	η_{DA}=1
Supply Elasticity | Assembly (ϵ_{SA})	ϵ_{SA}=1	ϵ_{SA}=1	ϵ_{SA}=2
Supply Elasticity | Components (ϵ_{SC})	ϵ_{SC}=1	ϵ_{SC}=1	ϵ_{SC}=2
Consumer Loss (adek)	79.9	70.5	79.9
Transfer to Assembly Industry (nlik)	39.8	39.8	31.8
Efficiency Loss (Assembled Autos) (def+lhi)	26.9	17.4	34.9
Transfer to Components Industry (oqtu)	4.5	4.5	4.3
Efficiency Loss (Components) (qrt)	0.2	0.2	0.4
Total Transfer to Producers (nlik+oqtu)	44.3	44.3	36.1
Total Efficiency Loss (def+lhi+qrt)	27.1	17.6	35.3
Consumer Cost per Unit Assembled (US$)	6834	6028	6834
Efficiency Loss per Unit Assembled (US$)	2314	1508	3017

FIGURE 1


ASSEMBLED VEHICLE MARKET
P_A
S_A
S_A'
$V(Q_A)$
αP_C^*
$\alpha(1-\delta)P_C^* t_K$
$\alpha\delta(P_C-P_C^*)+\alpha(1-\delta)x_K(P_C-P_C^*)P_C^*/P_C$
$t_A P_A^*$
$x_A((P_C-P_C^*)/P_C)P_A^*$
P_A^*
D_A
M_A
M_A^*
Q_A^* Q_A
D_A
D_A^* Q_A
DOMESTIC COMPONENTS MARKET
P_C
S_C
P_C^*
$\alpha\delta Q_A$
$x_K\alpha(1-\delta)Q_A(P_C^*/P_C)$
$x_A M_A(P_A^*/P_C)$
$D_C=D_{da}+D_{xk}+D_{xa}$
D_{da}
$D_{da}+D_{xk}$
Q_C^*
Q_C
Q_C

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